determined number of groups of cut amorphous metal strips arranged in a step-lap joint pattern, the segment having been formed and annealed and the segment being adapted by the presence of said pattern to be joined in a step-lap joint in said segmented transformer core, said transformer core segment having a C-segment, I-segment, or straight segment construction.

REMARKS

In order to emphasize the patentable distinctions of applicant's invention over the prior art, Claim 1 has been amended to incorporate the limitations of dependent claim 4 and claim 4 has been cancelled, without prejudice. As amended, claim 1 calls for at least one of the segments of the transformer core to be a C-segment, an I-segment, or a straight segment. Claim 28 has been amended to require that the segment be one of a C-segment, an I-segment, or a straight segment. Each of these amendments is clearly supported by the original specification, particularly at page 3, lines 7-9; page 6, lines 6-7; page 8, lines 16-18, and original claim 4. Consequently, no new matter has been added by the amendments.

Applicants' invention as recited by present claims 1, 7, 14-18, 20-25, and 28-36 provides a transformer core, segments for the construction thereof, and a transformer comprising such a core. Generally stated, each of the segments comprises a plurality of packets, and each of the packets comprises a pre-determined number of groups of cut amorphous metal strips arranged in a step-lap joint pattern. The segments are formed and then annealed, and the core is subsequently assembled from the formed and annealed segments. The core comprises at least one segment which is a C-segment, an I-segment, or a straight segment.

The segments are brought into juxtaposition to effect assembly of the core of the invention. The segments join in a step-lap joint. A core configuration and its joints are depicted, by Figs. 8-11, wherein segments 60, 70, and 80 meet at step-lap joints 33. Significantly, the segmentation of applicants' claimed core is circumferential. That is to say, the circumference of each magnetic circuit is interrupted by joints generally transverse to the circumference. This configuration of segmentation provides a distinct advantage in fabricating a finished transformer of the type recited by claims 34-36. It is much easier to provide electrical windings for the finished transformer of applicants' claims than for any transformer having a core that is wound of continuous strip that cannot be parted. Windings can conveniently be preformed with a requisite number of turns surrounding an aperture using any suitable technique. For example, the winding package may be self-supporting or disposed on a bobbin structure. The package then may be slipped over one or more of the core segments prior to the segments being brought together into closure to form the core. Alternatively, windings may be applied to an individual segment prior to its incorporation in the final core geometry.

Either method of providing windings is far easier to carry out than any process that must accommodate a continuously wound, closed core structure. Windings for a core of such a form must be laboriously laced through the core's center aperture. In many instances such a process is virtually impossible. The conductors needed for large transformers, especially those as large as the 100 kVA to 500 MVA ratings delineated by claim 36, generally are of a very large gage and so cannot be bent manually to the extent required to form the needed windings. Mechanical forming equipment is frequently too large to be accommodated and operated in the winding window in the middle of each core circuit.

Other significant advantages in manufacture and operation are afforded by use of the core segments for constructing the transformer core, as recited by applicants' amended claims 1, 7, 14-18, 20-25, and 28-36. Surprisingly, applicants' segmented transformer core overcomes substantial problems encountered in the practice of prior art methods, especially methods directed to wound core transformer construction. Significantly, cores having the structure recited by applicants' amended claims can be manufactured in a commercially viable manner for use in transformers having a size rating far larger than those made with alternative structures. As set forth in the specification at page 6, lines 21-24, and in present claim 36, the sizes of segmented amorphous metal transformer cores defined by present claims 1, 7, 14-18, 20-25 and 28-36 can advantageously be as large as 500 MVA. Wound core amorphous metal cores having high efficiency and power ratings of 10-100 kVA or more are presently available. While those cores have been used in distribution transformers for residential and light commercial service, the manufacture of much larger devices has been a formidable challenge. Notwithstanding the significant benefits derived from the prospect of comparable improvements and energy savings in these large devices, manufacturers have heretofore been unable to build large transformers in a commercially viable manner using known methods and structures. Stacked core methods that allow construction of large, conventional transformers incorporating silicon steel have proved to be impractical when replicated with amorphous metal. Significant problems attributed in part to the thin gage (typically 20-25 μm) and notoriously brittle nature of amorphous metal make it difficult to handle, especially in the annealed condition. As previously noted, wound core methods that presume handling, supporting, and annealing of entire cores cannot be scaled to make the larger core sizes required for industrial power ratings (ranging up to 500 MVA). Cores for power ratings much larger than 1 MVA necessarily weigh many hundreds of kilograms. The issues of handling, supporting, and annealing

entire cores are quite formidable. Accordingly, the advantages of high efficiency and low core loss previously obtained with small sized core containing devices that incorporate amorphous metal have remained elusive in transformers with rated capacity sufficiently large for heavy industrial and substation use.

By way of contrast, the transformer core defined by applicants' claims 1, 7, 14-18, 20-25, and 28-36 represents a highly significant advance in the art – a low core loss transformer that is efficiently manufactured in sizes heretofore considered to be inaccessible. The segmentation of the core called for by applicants' claims allows use of much simpler processing equipment. Cutting, forming, assembling, and annealing of each segment is accomplished much more easily than if a more massive core were to be processed as an entire unit at each stage of manufacture. When compared to wound cores made by conventional assembly methods, the cores delineated by applicants' claims exhibit lower internal stress, especially at the core corners. Annealing efficiencies are improved, since heat treatment schedules may be optimized to account for variation in heatup and cooldown times, as well as oven loading for segments whose sizes and shapes are substantially different. Material utilization is enhanced, and process yields are increased. Failures and material breakage inherently produced by the time consuming steps involved when repeatedly lacing and unlacing the cores during wound core construction are virtually eliminated. Significantly larger cores can be constructed at lower cost in a much more efficient, reliable manner.

Claims 1, 4, 7, 14-18, 20-25, and 28-36 were rejected under 35 U.S.C. 103(a) as being unpatentable over Japanese Patent Publication 61-15312 A (hereinafter "the Japanese publication") in view of U.S. Patent 5,063,654 to Klappert et al. In view of the cancellation of claim 4, this rejection will be discussed with respect to the remaining claims.

The Japanese publication is directed to a wound magnetic core comprised of continuously wound strips, e.g., as depicted by Fig. 3. As shown by the top view of Fig. 2, no joints are present in the disclosed core. The core is laterally segmented and comprises laterally adjacent, wound portions. For example, Fig. 6 depicts a central portion 6A flanked by side portions 6B. The cross-sectional view of Fig. 8 shows the abutment of portions 6A and 6B.

The Examiner has indicated that the Japanese publication discloses a segmented core structure comprising a plurality of segments, referencing Fig. 4. Each segment is said to comprise a plurality of packets (e.g., reference symbol 1), each having a predetermined number of groups (e.g., reference symbols 6A, 6B) of cut amorphous annealed metal.

Applicants respectfully submit that this interpretation is not in accord with applicants' usage of the terms "segments," "packets," and "groups" in claims 1, 4, 7, 14-18, 20-25, and 28-36. That usage is in accord with the discussion in the instant specification, e.g., at page 2, line 30 to page 3, line 8; page 5, lines 27-28; and with the depictions in the Figures, especially in Figs. 3-10. In particular, there is no indication or suggestion in the Japanese publication that the "packets" (1) are comprised of a number of groups of a plural number of cut amorphous strips, as required by claim 1. No cut lines are depicted, and the Examiner has not pointed to any suggestion in the Japanese publication to the contrary. The "groups" 6A and 6B of the Japanese publication are arranged with their sides abutting, as clearly seen in Figs. 1, 4, 6, and 8, taken in combination. Applicants teach instead that "each lamination group is arranged with its end in step lap position" (page 5, lines 2-3). It is thus respectfully submitted that the Japanese publication's items 6A and 6B do not constitute "groups," in applicants' sense of the term "group"; and that item 1 does not constitute a "packet" comprising a number of groups of a plural number of cut amorphous strips, in applicants' sense of the term "packet". Any core disclosed or suggested by the

Japanese publication therefore lacks the segmentation required by applicants' claims, and even more, it does not have even one segment having C, I, or straight construction.

The lack of any transverse cuts in the core disclosed by the Japanese publication inherently renders it incapable of being separated into segments on which windings may be applied prior to core assembly. This deficiency moots most, if not all, of the advantages afforded by the separability of the segments in applicants' core. In particular, the ability to expeditiously form windings either directly on each individual segment or in a prefabricated assembly slipped onto a segment is eliminated. Such winding procedures are highly advantageous in transformer production, as described hereinabove in greater detail.

Recognizing the lack of disclosure of step-lap joint patterns in the Japanese publication, the Examiner has proposed the combination of the Japanese publication and Klappert et al., which discloses a method of making packets for transformer core manufacture. The Examiner has indicated that Klappert et al. discloses a packet for a segmented core structure formed of groups of cut amorphous steel strips arranged in a step-lap joint pattern, referencing Fig. 6.

However, applicants respectfully traverse the Examiner's characterization of the object depicted by Fig. 6 as being a packet for a "segmented core structure." Applicants further submit that none of the cores disclosed or suggested by Klappert et al. is "segmented." In fact, the term "segmented," or any grammatical variant thereof, is not even present in the text of the Klappert et al. patent. There is no disclosure either in the text or in the figures of the Klappert et al. patent that suggests in any way whatsoever that a core can be assembled from a plurality of segments, in the sense of applicants' usage of that term, or otherwise. To the contrary, packets (such as that depicted by Fig. 6) are said to "surround" the core window (see col. 1, lines 26-27). The structure and use of Klappert et al.'s Fig. 6 packet is made clear at col. 7, lines 55-61, which states:

"After each packet is wrapped about the arbor, the joint formed at the mating ends of each packet can be examined either visually or by suitable sensing means and if the mating ends are not optimally positioned with respect to each other, the lengths of the sections making up the next packet can be appropriately adjusted to compensate for such variations."

It is respectfully submitted that this passage clearly establishes that a singular joint is formed by the two ends of a single packet being brought into mating relationship. Such a mating relationship cannot be extant in a core comprising a plurality of segments, wherein a given end of one segment adjoins the end of a different segment; not the same segment.

Even if the Japanese publication and the Klappert et al. patent were combined in the manner proposed by the Examiner, the resultant structure would not produce a core having a plurality of segments. Neither reference, taken alone, discloses or suggests a plural-segment core; a plural-segment core structure is not disclosed or suggested by the combined teachings of the references. To the contrary, any core disclosed or suggested by any combination of the cited references would have at most a single segment, which inherently could not be one of a C-, I-, or straight segment as required by present claim 28. Applicants respectfully submit that the combination of the Japanese publication and Klappert et al. thereby teaches away from any core structure recited by applicants' claims 1, 7, 14-18, 20-25, and 28-36. Only in light of applicants' own teaching does it become apparent that a multiple-segment core is highly beneficial and especially well suited for the construction of very large transformers of an electrical power distribution system.

The Examiner further suggests that it would have been obvious to one having ordinary skill to use the packet design of Klappert et al. for the packets of the Japanese publication for the purpose of facilitating joining and strengthening. However, as set forth by applicants at page 6, lines 13-24 of the specification, prior to applicants' unexpected discovery conventional fabrication methods for amorphous metal transformers severely limited the size of transformers that could be produced. Such methods were difficult or

impossible to employ in connection with any practical method for the large-scale construction of large devices, especially transformers as large as 500 MVA. As a result, the economic and societal benefits of more efficient transformers could not be obtained. The benefits of decreased core loss and improved efficiency already enjoyed by small amorphous devices were not obtainable in larger devices, notwithstanding the obvious desire to achieve the corresponding benefits. The Japanese publication and Klappert et al. had been available since 1986 and 1991, respectively. Yet no one, including Klappert et al. and the Japanese publication inventors, had recognized the advantages afforded by the segmented core and transformer called for by applicants' claims 1, 7, 14-18, 20-25, and 28-36, as amended.

Moreover, any core constructed in accordance with the combined teachings of the Japanese publication and Klappert et al. would be subject to the very problem set forth at page 8, lines 19-30. That is to say, such a core would require the tedious and trouble-prone steps of opening and closing joints in a wound core structure. Surprisingly, these problems, inherent to any core constructed in light of the combined teachings of the cited references, have been virtually eliminated by use of preformed segments that join in the step-lap configuration called for by applicants' claims.

The Examiner has stated that the Japanese publication discloses the invention defined by claims 4, 14-18, and 29-32 except for the specific segment design, which would have been an obvious design consideration.

This statement of the Examiner is, respectfully, traversed. As discussed hereinabove in greater detail, neither the Japanese publication nor Klappert et al. discloses or suggests a transformer core comprising a <u>plurality of segments</u>. For there to exist the possibility of a design choice, a designer must have available a repertoire of relevant possible designs or a range of relevant designs to be optimized. In the present situation, there exists neither a

repertoire of relevant possible designs nor a range thereof for an artisan to select from; this is so even in light of the proposed combination. The design choices, if any, for a core constructed in accordance with the combined teaching of the Japanese publication or Klappert et al. do not include selection of a segment type, let alone the choice of a segment type of C-section, I-section, and straight-section, as required by present claims 1 and 28, and claims 7, 14-18, 20-25, and 28-36, which are dependent thereon. Since applicants' recited segment structure differs from any structure disclosed or suggested by the combined teachings of the cited references, a finding of "obvious design choice" is precluded. In re Gal, 980 F.2d 717, 25 USPQ2d 1076 (Fed. Cir. 1992).

With respect to claims 21-24 and 34-36, the Examiner has indicated that the Japanese publication as modified discloses the instant claimed invention, except for the core being housed in an oil-filled or dry-type transformer, a distribution transformer, a power transformer or voltage conversion apparatus.

For the reasons set forth above, applicants respectfully submit that independent claims 1 and 28, from which claims 21-24 and 34-36 depend, are patentable over the cited references. Inasmuch as claims 21-24 and 34-36 further restrict their respective base claims, they are submitted to be patentable for at least the same reasons.

Claim 7 was rejected under 35 U.S.C. 103(a) as being unpatentable over the Japanese publication in view of Klappert et al. and further in view of U. S. Patent 3,538,474 to Olsen.

Olsen discloses a C-type cut transformer core in which the laminations are arranged in a plurality of groups. The ends of adjacent laminations forming each group of the core are offset, the offset being substantially uniform except for predetermined pairs of adjacent laminations which are offset from three to ten times the uniform offset. The transformer core is assembled, e.g. with two C-shaped sections. It is suggested that the assembly is

rendered difficult by the propensity of adjacent laminations to catch or snag each other as the sections are brought into mating relationship. The use of a smooth adhesive coating of a relatively low friction material and extension of the offset between adjacent laminations in preselected pairs of adjacent laminations are disclosed to address the deleterious effect of laminations catching or snagging during assembly. The patent further suggests the use of "grain oriented material" for the laminations.

Clearly, Olsen does not disclose a transformer core comprising amorphous metals. In fact, amorphous metals were not even known to exist, and could not be made at the time the Olsen patent was applied for.

Applicants respectfully submit that the combination of the Japanese publication, Klappert et al., and Olsen and does not suggest to one having ordinary skill in the art the invention set forth in amended claim 7. Rather, any transformer constructed in light of the combined teaching would differ in crucial respects from applicants' segmented transformer core and the segments comprised therein.

First, Olsen calls for a step lap structure in which <u>each</u> lamination is offset from the lamination adjacent thereto, whereas applicants' claim 7 inherits from claim 1, on which it depends, the requirements (i) that each <u>group</u>, comprising a <u>plurality</u> of laminations, be offset, and (ii) that the <u>individual</u> laminations within each group be <u>aligned</u>. It is important to recognize that cores suitable for transformers having ratings of 100 kVA or more must have limbs at least several inches thick. Olsen's structure may be practical for constructing a core using the relatively robust laminations he discloses (grain oriented material at least a few thousandths of an inch thick). However, a structure requiring individual positioning of thousands of laminations of amorphous metal, each of which is less than a thousandth of an inch (i.e., less than 25 μm) thick, needed to achieve the required build, would be highly impractical. Such a structure could not be readily achieved on a single-shot basis, let alone

repeatedly during commercial production. The difficulty is greatly exacerbated by the brittleness of amorphous metal after annealing.

Significantly, the Olsen core was disclosed in 1970 (more than 14 years before the filing date of the Japanese publication and more than 20 years before Klappert et al.). Yet up until the time of applicants' invention, there has existed no suggestion by any prior art worker, including the inventors of the Japanese publication and Klappert et al., concerning the advantages derived from use of a segmented core of the type disclosed by Olsen.

Olsen warns of the difficulty in assembling the C-sections of his core, noting the propensity of adjacent laminations to catch or snag each other as the sections are brought into mating relationship (col. 3, lines 26-35). On the other hand, the likelihood of annealed amorphous metal chipping and breaking due to its thin gage and extreme brittleness in making a wound amorphous metal core is well known in the amorphous metal art. Taking the Olsen, Japanese publication, and Klappert et al. teachings together would serve only to heighten the skilled worker's concern -- that using amorphous metal to construct an Olsen core would likely result in serious difficulties. It is therefore submitted that the skilled artisan would not have been motivated at the time of applicants' filing to combine the Olsen disclosure with the Japanese and Klappert et al. teachings.

Assuming, arguendo, that the teachings of Olsen, the Japanese publication and Klappert et al. were combined in the manner proposed by the Examiner, the resultant transformer would still not comprise homogeneous core segments. It is therefore submitted that the proposed combination of Olsen with the Japanese publication and Klappert et al. cannot be properly made in the absence of applicants' own disclosure. Even then the proposed combination would require substantial reconstruction and redesign, which is not fairly taught by the references. On the other hand, the significant structural and operational advantages discussed hereinabove, permit construction of significantly larger

cores at lower cost in a more efficient and reliable manner. These structural and operational advantages are achieved as the direct result of the elements delineated by amended claim 7. It is only in light of applicants' own disclosure that these significant benefits are realized.

Furthermore, it is significant that Olsen calls for the adherent material to be applied to the ends of the laminations (see col. 1, lines 63-65; col. 4, lines 66-70; and claims 7 and 11). The Olsen teaching states that the particular material chosen is not critical. Applicants' claim 7, on the other hand, calls for the edges of the laminations to be coated with a bonding material. The step lap region is specifically excluded and use of epoxy resin is specifically taught (page 6, line 1) as exemplary. Moreover, as shown by Figs. 5-9 and 11 of applicants' specification, the location of coating 51 does not include the ends of the laminations. Accordingly, applicants respectfully submit that the Olsen teaching of coated ends points away from the invention recited by claims 7 and 32, wherein the edges, and not the ends, of the laminations are coated.

In view of the foregoing remarks, it is submitted that the present invention as recited by present claim 7 patentably defines over the Japanese publication, Klappert et al, and Olsen.

Accordingly, reconsideration of the rejection of claim 7 under 35 U.S.C. 103(a) as being obvious over the combination of the Japanese publication, Klappert et al, and Olsen is respectfully requested.

Claim 20 was rejected under 35 U.S.C. 103(a) over the combination of the Japanese publication as modified and applied to claim 1, and further in view of U. S. Patent 2,465,798 to Granfield.

Granfield discloses a magnetic core having a cruciform cross-section and comprising lamination layers of different magnetic materials, i.e., both hot and cold rolled

steel materials. The laminations are disclosed to be joined at the corner of each step or section using an alternate butt and overlap joint or a miter joint. Granfield discloses that lower losses are obtained in a core wherein the hot rolled steel is concentrated in the outer laminations and the cold rolled steel is concentrated in the inner laminations than vice versa.

For the reasons previously set forth in connection with the rejection of claims 1, 4, 7, 14-18, 20-25, and 28-36 under 35 U.S.C. 103(a), applicants respectfully submit that the Japanese publication does not suggest the invention recited in amended claim 1. The Granfield disclosure, which long predates the discovery of amorphous metal, does not cure this lack of disclosure by the Japanese publication. Moreover, the core disclosed by Granfield clearly is a stacked core, in which an alternate butt and overlap joint or a miter joint is present at the corner of each step or section. The recitation of this structure teaches away from the invention delineated by claim 20, which may incorporate C-segments or I-segments, each of which has a corner without a joint. Granfield also teaches away from the invention of claim 20, in that alternate butt and overlap joints and miter joints are disclosed, not the step-lap joint applicants require. Applicants thus respectfully submit that present claim 20 is patentable over any combination of the Japanese publication and Granfield.

Accordingly, reconsideration of the rejection of Claim 20 under 35 U.S.C. 103(a) as being obvious over the Japanese publication as modified, and further in view of Granfield is respectfully requested.

Claims 25 and 33 were rejected under 35 U.S.C. 103(a) over the Japanese publication as modified and further in view of U. S. Patent 4,450,206 to Ames et al. The Examiner has indicated that it would have been obvious to use the amorphous metal strip of Ames et al. in the Japanese publication.

Ames et al. discloses an amorphous Fe-B-Si alloy having improved castability while maintaining good magnetic properties, ductility, and improved thermal stability. The alloy provided generally consists essentially of 6-10% B, 14-17% Si, 0.1-4% Cr, and the balance iron, with no more than incidental impurities. The Cr content is said to be "critical" (col. 4, line 41) and to improve the fluidity characteristics and amorphousness of the alloy, to unexpectedly improve the molten metal puddle control during the casting of the alloy, and to improve the corrosion resistance of the Fe-B-Si alloys.

Claims 25 and 33 call for an alloy composition having an "M" component present in the range of 70-85 at.%, of which up to 10 at.% Ti, V, Cr, Mn, Cu, Zr, Nb, Mo, Ta and W may be replaced; 5-20 at.% of a "Y" component that is at least one of B, C and P; and a "Z" component having 0-20 at.% of at least one of Si, Al and Ge. Applicants respectfully submit that the Ames et al. composition clearly sets forth different ranges for each of the constituents. For example, applicants alloy may contain 5-20% B and 0-20% Si, whereas Ames requires 6-10% and 14-17%, respectively. Ames et al. calls the presence of 0.1-4% Cr "critical," whereas presence of Cr in applicants' alloy is merely optional.

Moreover, Ames et al. does not disclose a segmented transformer core, let alone the particular core construction required by applicant's claims 1 and 28, from which claims 25 and 33 depend. In this respect Ames et al. fails to cure the deficiencies of the Japanese publication with respect to any of applicants' claims.

For these reasons, it is respectfully submitted that applicants' claims 25 and 33 are patentable over any combination of the Japanese publication as modified and Ames et al. Accordingly, reconsideration of the rejection of claims 25 and 33 under 35 U.S.C. 103(a) as being obvious over the Japanese publication as modified and further in view of Ames et al. is requested.

In view of the cancellation of claim 4, the amendments to claims 1 and 28 and the foregoing remarks, it is submitted that the present application is in allowable condition. Reconsideration of the rejection of present claims 1, 7, 14-18, 20-25, and 28-39, entry of this amendment, and allowance of the application are, therefore, earnestly solicited.

Respectfully submitted,

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Amended Claims - Version With Markings To Show Changes Made

1. (Six times amended) A transformer core comprising a plurality of segments, each of which comprises of a plurality of packets, said packets each comprising a pre-determined number of groups of cut amorphous metal strips arranged in a step-lap joint pattern, each of said segments having been formed and annealed and said core having been assembled from said annealed segments, and wherein at least one core segment has a C-segment, I-segment or straight segment construction.

~~4. A transformer core according to claim 1 wherein at least one core segment has a C-segment, I-segment or straight segment construction.~~

7. A transformer core according to claim 1, wherein edges of each of said core segments are coated with a bonding material that protects said edges and imparts increased mechanical strength.

14. A transformer core according to claim 1, comprising two C segments.

15. A transformer core according to claim 14, comprising two C segments and an even number of straight segments.

16. A transformer core according to claim 1, comprising four C segments arranged to form a shell-type core.

17. A transformer core according to claim 1, comprising two C segments and one I segment arranged to form a shell-type core.

18. A transformer core according to claim 1, comprising two C segments, one I segment and an even number of straight segments arranged to form a three-leg transformer core.

20. A transformer core according to claim 1, wherein at least one core segment has a cruciform shaped cross-section.

25. A transformer core as recited by claim 1, wherein each of said amorphous metal strips has a composition according to the formula: $M_{70-85}\ Y_{5-20}\ Z_{0-20}$, subscripts in atom percent, where "M" is at least one of Fe, Ni and Co, "Y" is at least one of B, C and P, and "Z" is at least one of Si, Al and Ge; with the provisos that (i) up to 10 atom percent of component "M" can be replaced with at least one of the metallic species Ti, V, Cr, Mn, Cu, Zr, Nb, Mo, Ta and W, and (ii) up to 10 atom percent of components (Y + Z) can be replaced by at least one of the non-metallic species In, Sn, Sb and Pb.

28. (Twice Amended) For use in a segmented transformer core, a transformer core segment comprising a plurality of packets, each of which comprises a pre-determined number of groups of cut amorphous metal strips arranged in a step-lap joint pattern, the segment having been formed and annealed and the segment being adapted by the presence of said pattern to be joined in a step-lap joint in said segmented transformer core, <u>said transformer core segment having a C-segment, I-segment, or straight segment construction.</u>

29. An annealed transformer core segment according to claim 28 having a C-segment construction.

30. An annealed transformer core segment according to claim 28 having an I-segment construction.

31. An annealed transformer core segment according to claim 28 having a straight segment construction.

32. An annealed transformer core segment according to claim 28 further comprising a bonding material adhered to edges of said annealed transformer core segment.

33. An annealed transformer core segment according to claim 28 wherein each of the amorphous metal strips has a composition according to the formula: $M_{70-85} Y_{5-20} Z_{0-20}$, subscripts in atom percent, where "M" is at least one of Fe, Ni and Co, "Y" is at least one of B, C and P. and "Z" is at least one of Si, Al and Ge; with the provisos that (i) up to 10 atom percent of component "M" can be replaced with at least one of the metallic species Ti, V, Cr, Mn, Cu, Zr, Nb, Mo, Ta and W, and (ii) up to 10 atom percent of components (Y + Z) can be replaced by at least one of the non-metallic species In, Sn, Sb and Pb.

34. A transformer comprising a transformer core according to claim 1.

35. An oil cooled transformer comprising a transformer core according to claim 1.

36. A transformer according to claim 34 having a duty rating of from 100 KVA to 500 MVA.

37. A process for the production of a transformer core from a plurality of individually annealed core segments which process comprises the steps of:

providing a plurality of metal strips,

stacking said amorphous metal strips to form a core segment comprising at least one packet which includes a plurality of groups of amorphous metal strips arranged in a step-lap joint pattern;

optionally forming said stacked amorphous metal strips to form a C-segment or an I-segment;

subsequently annealing said core segment;

subsequently assembling a transformer core by mating joints of at least two annealed core segments.

38. The process according to claim 37 wherein the core segment is annealed in the presence of a magnetic field.

39. The process according to claim 37 which includes the further process step of:

adhering a bonding material to edges of the annealed core segment.

Amended Claims - Version Without Markings

1. (Six Times Amended) A transformer core comprising a plurality of segments, each of which comprises of a plurality of packets, said packets each comprising a pre-determined number of groups of cut amorphous metal strips arranged in a step-lap joint pattern, each of said segments having been formed and annealed and said core having been assembled from said annealed segments, and wherein at least one core segment has a C-segment, I-segment or straight segment construction.

7. A transformer core according to claim 1, wherein edges of each of said core segments are coated with a bonding material that protects said edges and imparts increased mechanical strength.

14. A transformer core according to claim 1, comprising two C segments.

15. A transformer core according to claim 14, comprising two C segments and an even number of straight segments.

16. A transformer core according to claim 1, comprising four C segments arranged to form a shell-type core.

17. A transformer core according to claim 1, comprising two C segments and one I segment arranged to form a shell-type core.

18. A transformer core according to claim 1, comprising two C segments, one I segment and an even number of straight segments arranged to form a three-leg transformer core.

20. A transformer core according to claim 1, wherein at least one core segment has a cruciform shaped cross-section.

25. A transformer core as recited by claim 1, wherein each of said amorphous metal strips has a composition according to the formula: M_{70-85} Y_{5-20} Z_{0-20}, subscripts in atom percent, where "M" is at least one of Fe, Ni and Co, "Y" is at least one of B, C and P, and "Z" is at least one of Si, Al and Ge; with the provisos that (i) up to 10 atom percent of component "M" can be replaced with at least one of the metallic species Ti, V, Cr, Mn, Cu, Zr, Nb, Mo, Ta and W, and (ii) up to 10 atom percent of components (Y + Z) can be replaced by at least one of the non-metallic species In, Sn, Sb and Pb.

28. (Twice Amended) For use in a segmented transformer core, a transformer core segment comprising a plurality of packets, each of which comprises a pre-determined number of groups of cut amorphous metal strips arranged in a step-lap joint pattern, the segment having been formed and annealed and the segment being adapted by the presence of said pattern to be joined in a step-lap joint in said segmented transformer core, said transformer core segment having a C-segment, I-segment, or straight segment construction.

29. An annealed transformer core segment according to claim 28 having a C-segment construction.

30. An annealed transformer core segment according to claim 28 having an I-segment construction.

31. An annealed transformer core segment according to claim 28 having a straight segment construction.

32. An annealed transformer core segment according to claim 28 further comprising a bonding material adhered to edges of said annealed transformer core segment.

33. An annealed transformer core segment according to claim 28 wherein each of the amorphous metal strips has a composition according to the formula: M_{70-85} Y_{5-20} Z_{0-}

$_{20}$, subscripts in atom percent, where "M" is at least one of Fe, Ni and Co, "Y" is at least one of B, C and P. and "Z" is at least one of Si, Al and Ge; with the provisos that (i) up to 10 atom percent of component "M" can be replaced with at least one of the metallic species Ti, V, Cr, Mn, Cu, Zr, Nb, Mo, Ta and W, and (ii) up to 10 atom percent of components (Y + Z) can be replaced by at least one of the non-metallic species In, Sn, Sb and Pb.

34. A transformer comprising a transformer core according to claim 1.

35. An oil cooled transformer comprising a transformer core according to claim 1.

36. A transformer according to claim 34 having a duty rating of from 100 KVA to 500 MVA.

37. A process for the production of a transformer core from a plurality of individually annealed core segments which process comprises the steps of:

providing a plurality of metal strips,

stacking said amorphous metal strips to form a core segment comprising at least one packet which includes a plurality of groups of amorphous metal strips arranged in a step-lap joint pattern;

optionally forming said stacked amorphous metal strips to form a C-segment or an I-segment;

subsequently annealing said core segment;

subsequently assembling a transformer core by mating joints of at least two annealed core segments.

38. The process according to claim 37 wherein the core segment is annealed in the presence of a magnetic field.

39. The process according to claim 37 which includes the further process step of:

adhering a bonding material to edges of the annealed core segment.

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